

PRELIMINARY SENSORIMOTOR AND CARDIOVASCULAR RESULTS FROM THE JOINT RUSSIAN/U.S. PILOT FIELD TEST IN PREPARATION FOR THE FULL FIELD TEST

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Ongoing collaborative research efforts between NASA's Neuroscience and Cardiovascular Laboratories, and the Institute of Biomedical Problems' (IBMP) Sensory-Motor and Countermeasures Laboratories have been measuring functional sensorimotor, cardiovascular and strength responses following bed rest, dry immersion, short-duration (Space Shuttle) and long-duration (Mir and International Space Station [ISS]) space flights. While the unloading paradigms associated with dry immersion and bed rest does serve as acceptable flight analogs, testing of crew responses following the long-duration flights previously has not been possible until a minimum of 24 hours after landing. As a result, it is not possible to estimate the nonlinear trend of the early (<24 hours) recovery process nor is it possible to accurately assess the full impact of the decrements associated with long-duration flight. To overcome these limitations, both the Russian and U.S. programs have implemented testing at the landing site. By joint agreement, this research effort has been identified as the functional *Field Test* (FT). For practical reasons the FT has been divided into two phases: the full FT and a preliminary pilot version (PFT) of the FT that is reduced in both length and scope.

The primary goal of this research is to determine functional abilities in long-duration space-flight crews beginning as soon after landing as possible (< 2 hours) with one to three immediate follow-up measurements on the day of landing. This goal has both sensorimotor and cardiovascular elements, including evaluations of NASA's new anti-orthostatic compression garment and the Russian Kentavr garment. Functional sensorimotor measurements will include, but are not limited to, assessing hand/eye coordination, egressing from a seated position, walking normally without falling, measuring of dynamic visual acuity, discriminating different forces generated with both the hands and legs, recovering from a fall, coordinated walking involving tandem heel-to-toe placement, and determining postural ataxia while standing. The cardiovascular portion of the investigation includes measuring blood pressure and heart rate during a timed stand test in conjunction with postural ataxia testing (quiet stance sway) as well as cardiovascular responses during the other functional tasks. In addition to the immediate post-landing collection of data for the full FT, postflight data will be acquired between one and three more other times within the 24 hours after landing and will continue over the subsequent weeks until functional sensorimotor and cardiovascular responses have returned to preflight normative values.

The PFT represents a single trial run comprised of a jointly agreed upon subset of tests from the full FT and relies heavily on IBMP's Sensory-Motor and Countermeasures Laboratories for content and implementation. The PFT has been collected on several ISS missions. Testing included: (1) a sit-to-stand test, (2) recovery from a fall where the crewmember began in the prone position on the ground and then stood for 3 minutes while cardiovascular stability was determined and postural ataxia data were acquired, and (3) a tandem heel-to-toe walk test to determine changes in the central locomotor program. Video, cardiovascular parameters (heart rate and blood pressure), data from body-worn inertial sensors, and severity of postflight motion sickness were collected for each test session.

In summary, the level of functional deficit is expected to be most profound during the acquisition of gravity loads immediately after landing when the demands for crew intervention in response to emergency operations will be greatest. Clearly measureable performance parameters such as ability to perform a seat egress, recover from a fall or the ability to see clearly when walking, and related physiologic data (orthostatic responses) are required to provide an evidence base for characterizing programmatic risks and the degree of variability among crewmembers for exploration missions where the crew will be unassisted after landing. Overall, these early functional and related physiologic measurements will allow estimation of nonlinear sensorimotor and cardiovascular recovery trends that has not been previously captured in over 50 years of space flight.